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Remediation Plan for Landfill Gas Exceedance at Terrace Heights GP-2

March 1, 2024

Dear Steven,

This letter presents a remediation plan to address exceedances of the lower explosive limit (LEL, 5%) for methane at gas probe cluster GP-2 (GP-2S and GP-2D) at the Terrace Heights Landfill in Yakima, Washington. GP-2 is located on the southern property boundary adjacent to Roza Hill Drive (Figure 1).

1 Monitoring Data Confirm Exceedance

Methane is intermittently detected at gas probe cluster GP-2 (Table 1).

- Methane was detected at 28.1% by volume at GP-2S on December 6, 2023. All other southern gas probes were non-detect.
- Methane began daily monitoring on February 24, 2024.
- Daily measurements have indicated variable methane concentrations at GP-2 (GP-2S and GP-2D) with a maximum of 34.3% by volume at GP-2S and a minimum of non-detect.
- All other southern gas probes (GP-1, GP-3, GP5 & GP-8 clusters) have been below 0.1% methane by volume during daily monitoring.

The data indicate a zone of perimeter exceedance near GP-2 that is bounded to the west by gas probes GP-1, GP-8 and bounded to the west by GP-5. The intermittent detections indicate that the edge of the LFG plume in the vadose zone is sensitive to barometric pressure variations.

1.1 Offsite Structure Monitoring

Offsite structures south of GP-2 were checked on February 23 and 26, 2024 as follows:

- 7802 Roza Hill Dr was checked with a GEM 5000 on February 23, 2024 with no methane detections. Structures at 7630 and 7632 Roza Hill Dr were not accessible.

- Structures at 7802, 7630, and 7632 Roza Hill Drive were checked on February 26, 2024 with an explosive gas detector with a detection range of 0-10,000 ppm. All readings were non-detect for methane and were below the 100 ppm regulatory limit.

The construction at all three premises was primarily slab on grade construction. Indoor air was checked at a minimum of 3 rooms at each address.

1.2 Extent of Exceedances

The available information indicates that methane above the LEL migrates to GP-2 except during times of elevated barometric pressure. The extent of the exceedance is bounded to the east and west by GP-5 and GP-1.

2 Preliminary Review of Gas Extraction System

A preliminary review of the gas extraction system was conducted on February 23 and 26, 2024. Two gas extraction wellhead hoses were found to be damaged on February 23 resulting in vacuum leak. The hoses were temporary repaired pending full system evaluation.

Vacuum was measured at the wellhead ports of extraction well pairs A-1 through A-6 (Figure 1) and at a measurement port just upstream of the blower on February 26, 2024. Preliminary values indicate that the system is operating at a vacuum below 2014 values (Table 2).

3 Conceptual Model for Exceedance

The available information indicates that the southern gas control system is only partially intercepting landfill gas along the southern edge of refuse. The gas extraction system appears to be operating at a lower than expected vacuum. Performance of the landfill gas extraction system below design vacuum and flow rates could result in migration of landfill gas beyond the gas extraction system resulting in the observed exceedances at GP-2.

Impaired performance of the gas extraction system associated with low system vacuum could be due to:

- Damage to the blower system reducing flow capacity.
- Breaks in the system piping resulting in air incursion.
- Improper setting of system components relative to site conditions.

The proposed remedial actions to evaluate these potential causes and resolve them is described in the next section.

4 Proposed Remedy

Proposed remedial actions include both southern gas control system inspection and adjustment or repair, and monitoring elements.

4.1 Inspection, Adjustment and Repair Elements

A landfill engineer to inspect the southern gas control system to:

- Visually inspect for breaks that may be causing vacuum leaks.
- Understand system operating vacuum and adjust if possible/necessary.
- Provide recommendations on system repairs, adjustments, or other corrective actions.

If repairs or deviations from operating records are noted, the system will be repaired or adjusted to correct to baseline operating conditions.

Increased vacuum and flow rates are expected to resolve perimeter gas exceedances of the LEL at GP-2.

If repairs or modifications to the southern gas extraction system are indicated by the Engineer's review, then those will be evaluated for how they would dovetail with the upcoming full landfill gas control system that is anticipated to start construction later in 2024. The full landfill gas control system will supersede the southern gas control system once it becomes operational.

4.2 Monitoring Elements

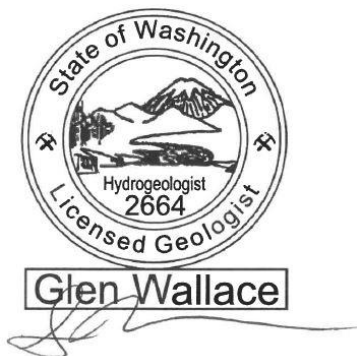
Ongoing work will include the following monitoring elements:

- Monitoring will be continued on a daily basis or other schedule as agreed in writing by letter or email by the Yakima Health District until southern perimeter gas probes are shown to be consistently below the LEL.
- Offsite structures at 7802, 7630, and 7632 Roza Hill Drive will be checked on a daily basis or other schedule as agreed in writing by letter or email by the Yakima Health District using an explosive gas detector with a detection limit less than 100 ppm.
- Monitoring will be adjusted in communication with Yakima Health District if LEL exceedances are detected at southern gas monitoring probes other than GP-2.
- Monitoring will return to quarterly frequency following resolution of the perimeter exceedance and written approval from the Yakima Health District.

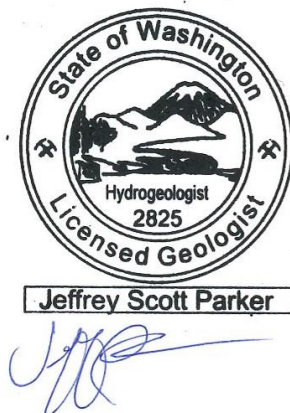
5 Closing

We trust that this letter provides the necessary information. We look forward to continuing working together on resolving the perimeter gas exceedances.

Regards,



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Attachments:

Table 1. Landfill Gas Monitoring Data, South Perimeter Probes

Table 2. Preliminary Extraction Well Vacuum Measurements

Figure 1. Terrace Heights Site Map

Table 1. Landfill Gas Monitoring Data, South Perimeter Probes

Terrace Heights Landfill

Probe	Date	Time	CH4 (% total)	CO2 (% total)	O2 (% total)
GP-1S	2/22/2024	10:16	0	1	20.6
GP-2S	2/22/2024	9:58	0	0.2	21.2
GP-2D	2/22/2024	10:01	0	0.3	20.8
GP-3S	2/22/2024	9:39	0	0.4	19.6
GP-3M	2/22/2024	9:41	0	0.7	19
GP-3D	2/22/2024	9:43	0	0.4	20.5
GP-5M	2/22/2024	9:26	0	0.1	21.3
GP-5D	2/22/2024	9:29	0	0.1	21.3
GP-8M	2/22/2024	10:29	0	0.1	21.5
GP-8D	2/22/2024	10:39	0	0.7	18.6
GP-1S	2/22/2024	4:51:00 PM	0	1	20.4
GP-2S	2/22/2024	4:41:00 PM	0	1.2	20.5
GP-2D	2/22/2024	4:43:00 PM	10.5	7.1	0.2
GP-3S	2/22/2024	4:00:00 PM	0	0.4	19.7
GP-3M	2/22/2024	4:02:00 PM	0	1.3	17.8
GP-3D	2/22/2024	4:05:00 PM	0	1.9	17.8
GP-5M	2/22/2024	4:33:00 PM	0	0.1	21.4
GP-5D	2/22/2024	4:35:00 PM	0	0.1	21.4
GP-8M	2/22/2024	4:56:00 PM	0	0.1	21.6
GP-8D	2/22/2024	4:58:00 PM	0	1	16.6
GP-1S	2/23/2024	5:05:00 PM	0	1.1	19
GP-2S	2/23/2024	5:11:00 PM	11	5.4	1.4
GP-2D	2/23/2024	5:11:00 PM	11.3	7.4	0
GP-3S	2/23/2024	5:34:00 PM	0	0.5	19.6
GP-3M	2/23/2024	5:34:00 PM	0	1.3	17.9
GP-3D	2/23/2024	5:34:00 PM	0	2	18.3
GP-5M	2/23/2024	5:25:00 PM	0	1.6	20
GP-5D	2/23/2024	5:25:00 PM	0	0.8	20.3
GP-8M	2/23/2024	5:00:00 PM	0	1.7	14.9
GP-8D	2/23/2024	5:00:00 PM	0	1.4	14.4
GP-1S	2/26/2024	2:18:00 PM	0	1.7	9.8
GP-2S	2/26/2024	2:06:00 PM	20.5	10.2	0.1
GP-2D	2/26/2024	2:10:00 PM	2.5	5.9	0
GP-3S	2/26/2024	12:42:00 PM	0	0.6	18.6
GP-3M	2/26/2024	12:46:00 PM	0	1.6	17.4
GP-3D	2/26/2024	12:50:00 PM	0	2.1	17.8
GP-5M	2/26/2024	1:53:00 PM	0	1.7	20.3
GP-5D	2/26/2024	1:57:00 PM	0	0.7	20.3
GP-8M	2/26/2024	2:24:00 PM	0	1.8	14.7

Bold indicates value above LEL (5% by volume)

Page 1 of 3

Barometric Pressure was 28.27 inches of water on 2/26/2024.

Probe	Date	Time	CH4 (% total)	CO2 (% total)	O2 (% total)
GP-8D	2/26/2024	2:27:00 PM	0	1.3	14.7
GP-1S	2/25/2024	8:13:00 AM	0	1.5	9.8
GP-2S	2/25/2024	7:57:00 AM	34.3	11.8	0
GP-2D	2/25/2024	8:04:00 AM	5.5	6.4	0
GP-3S	2/25/2024	7:26:00 AM	0	0.7	18.3
GP-3M	2/25/2024	7:31:00 AM	0	1.5	17.5
GP-3D	2/25/2024	7:38:00 AM	0	2.1	18.1
GP-5M	2/25/2024	7:46:00 AM	0	1.7	20.1
GP-5D	2/25/2024	7:51:00 AM	0	0.7	20.6
GP-8M	2/25/2024	8:25:00 AM	0	1.8	14.6
GP-8D	2/25/2024	8:29:00 AM	0	1.4	14.7
GP-1S	2/24/2024	2:08:00 PM	0	1.3	13.6
GP-2S	2/24/2024	2:16:00 PM	27.8	10.4	0.1
GP-2D	2/24/2024	2:21:00 PM	8.4	6.7	0
GP-3S	2/24/2024	2:49:00 PM	0	0.6	19.1
GP-3M	2/24/2024	2:53:00 PM	0	1.4	17.7
GP-3D	2/24/2024	2:57:00 PM	0	2	18.2
GP-5M	2/24/2024	2:33:00 PM	0	1.6	20.1
GP-5D	2/24/2024	2:37:00 PM	0	0.7	20.6
GP-8M	2/24/2024	1:47:00 PM	0	1.8	13.8
GP-8D	2/24/2024	1:52:00 PM	0	1.3	13.9
GP-1S	2/27/2024	9:14:00 AM	0	0.4	21.4
GP-2S	2/27/2024	8:57:00 AM	0.1	2	19.9
GP-2D	2/27/2024	9:02:00 AM	2.3	5.8	0.2
GP-3S	2/27/2024	8:33:00 AM	0.1	0.4	19.9
GP-3M	2/27/2024	8:37:00 AM	0	0.8	19.4
GP-3D	2/27/2024	8:40:00 AM	0	0.1	21.6
GP-5M	2/27/2024	8:47:00 AM	0	0.1	21.9
GP-5D	2/27/2024	8:51:00 AM	0	0.1	22
GP-8M	2/27/2024	9:18:00 AM	0	0.1	22.2
GP-8D	2/27/2024	9:21:00 AM	0	0.1	22
GP-1S	2/28/2024	9:15:00 AM	0	1.5	13
GP-2S	2/28/2024	9:29:00 AM	25.3	10.4	0.2
GP-2D	2/28/2024	9:24:00 AM	5.2	6.2	0.1
GP-3S	2/28/2024	10:07:00 AM	0	0.7	18.5
GP-3M	2/28/2024	10:10:00 AM	0	1.4	17
GP-3D	2/28/2024	10:14:00 AM	0	2.1	18.3
GP-5M	2/28/2024	9:55:00 AM	0	1	20.9
GP-5D	2/28/2024	9:59:00 AM	0	0.7	20.8
GP-8M	2/28/2024	9:10:00 AM	0	0.1	21.3
GP-8D	2/28/2024	9:05:00 AM	0	0.1	21.3
GP-1S	2/29/2024	11:13:00 AM	0.3	1.7	4.7

Bold indicates value above LEL (5% by volume)

Page 2 of 3

Barometric Pressure was 28.27 inches of water on 2/26/2024.

Probe	Date	Time	CH4 (% total)	CO2 (% total)	O2 (% total)
GP-2S	2/29/2024	11:28:00 AM	27.9	10.4	0.1
GP-2D	2/29/2024	11:24:00 AM	1.1	6	0.1
GP-3S	2/29/2024	11:53:00 AM	0	0.9	17
GP-3M	2/29/2024	11:57:00 AM	0	1.6	17.6
GP-3D	2/29/2024	12:01:00 PM	0	2.1	17.9
GP-5M	2/29/2024	11:38:00 AM	0	1.7	19.7
GP-5D	2/29/2024	11:42:00 AM	0	0.7	20.1
GP-8M	2/29/2024	11:06:00 AM	0	1.7	14.6
GP-8D	2/29/2024	11:02:00 AM	0	1.3	14.2

Bold indicates value above LEL (5% by volume)

Page 3 of 3

Barometric Pressure was 28.27 inches of water on 2/26/2024.

Table 2. Preliminary Extraction Well Vacuum Measurements

Terrace Heights Landfill

Location		2014 Reference	2/26/2024
Barometric (in Hg)		28.42	28.27
A1	Deep	-12.39	-5.17
	Shallow	-12.63	-5.83
A2	Deep	-12.59	-4.95
	Shallow	-6.49	-5.13
A3	Deep	-12.58	-4.88
	Shallow	-12.61	-5.19
A4	Deep	-12.51	-5.09
	Shallow	-8.28	-5.1
A5	Deep	-12.40	-1.98
	Shallow	-7.18	-2.45
A6	Deep	-12.42	-1.80
	Shallow	-12.17	-1.99
At Blower		--	-4.99

All wellhead vacuum/pressures in inch H₂O.



- | | | | | | |
|--|-------------------|--|---------------------|--|---|
| | Landfill Boundary | | Existing Gas Probe | | Gas Vent (locations approximate pending survey) |
| | Limit of Waste | | GW Monitoring Well | | |
| | Parcels | | Gas Extraction Well | | |
| | | | Production Well | | |
| | | | Test Boring | | |

LiDAR from Puget Sound LiDAR Consortium (PSLC), 2003
Ortho from NRCS, 2009

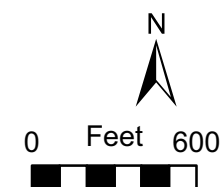


Figure 1
Terrace Heights
Site Map

Terrace Heights Landfill
Yakima, WA

